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Data Sources and Methods for the Air Pollutant Emissions Indicators

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1 Introduction

The Air Pollutant Emissions indicators (http://ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=E79F4C12-1) are part of the Canadian Environmental Sustainability Indicators (CESI) program (http://ec.gc.ca/indicateurs-indicators/default.asp?lang=En&n=47F48106-1), which provides data and information to track Canada's performance on key environmental sustainability issues. This indicator is also used to measure progress towards the goals and targets of the Federal Sustainable Development Strategy (http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1).

The Air Pollutant Emissions indicators track the emissions of key air pollutants that contribute to smog and acid rain in Canada, and that can adversely affect the health of Canadians and the environment. These indicators inform Canadians on the levels of air pollutants that are emitted in Canada. The air pollutant emissions indicators also help the government to identify priorities, track progress, and develop strategies and policies for reducing or controlling air pollution.

2 Description and rationale of the Air Pollutant Emissions indicators

2.1 Description

The Air Pollutant Emissions indicators track the total emissions of key air pollutants from anthropogenic (human-related) sources.[1] These air pollutants are sulphur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOC), ammonia (NH_3), carbon monoxide (CO), total particulate matter (TPM), respirable particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$).

For each air pollutant, the indicators are provided at the national level. They also identify the major sources of emissions and provide links to the detailed information on air pollutant emissions from facilities.[2]

2.2 Rationale

Canadians are exposed to these air pollutants on a daily basis, which can cause adverse health and environmental effects. $PM_{2.5}$ and ground-level ozone (O_3) are key components of smog and have been associated with pulmonary and cardiovascular health issues. While causing effects of their own, NO_X (such as nitrogen dioxide [NO_2]) and VOC are the main contributors to the formation of O_3. NO_X, SO_X (such as sulphur dioxide [SO_2]), NH_3 and VOC also lead to the formation of $PM_{2.5}$ in the air, while $PM_{2.5}$ is also emitted directly. SO_X and NO_X can also lead to the formation of acid deposition that can harm the environment, materials, living organisms, and humans.

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[1] Emissions from natural sources (such as biogenics) and open sources (such as road dust) are not included. However, emissions from open sources related to waste (such as landfills) and from the agriculture activities for NH_3 were included.

[2] Only the facilities that had air pollutant emissions over a certain reporting threshold were included in the National Pollutant Releases Inventory (NPRI) reported data.

These indicators are intended as pressure indicators to inform decision-makers and the public about the state of the environment and the progress toward improved ambient air quality in Canada associated with emission reduction measures.

2.3 Recent changes

Emission estimates for transportation sources such as road, off-road, air and marine have been updated using new emission estimation methods. Updates to the data and the emissions estimates were also done for all air pollutants resulting in some changes to the historical estimates. The data for ammonia are no longer dependent on two separate estimation methods and have a common methodology for all years. Finally, the emissions from the open source "waste", which includes landfill sites, water and sewage treatment, energy from waste, and open burning, were included in the indicators. For more information about the new changes consult the data highlights (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1#X-201302081512532) from the 2012 Air Pollutant Emission Summaries and Historical Emission Trends (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1).

Emissions at the provincial and territorial level were not included in this update as the underlying data was not available at the time of the compilation of the indicators due to a methodological review now underway at Environment Canada. This review is being conducted in consultation with provinces and territories. Once finalized, the source data by province and territory will be available online at Environment Canada's Air Pollutant Emission Summaries and Historical Emission Trends (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1).

3 Data

3.1 Data source

The Air Pollutant Emissions indicators used in CESI are based on Canada's Air Pollutant Emissions Inventory (APEI) data. The APEI summaries and trends (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1) include emissions reported by facilities to the National Pollutant Release Inventory (NPRI), as well as emissions estimated by Environment Canada using the latest estimation methods, published statistics or other sources of information such as surveys and reports. The APEI summaries and trends are compiled in collaboration with provincial, territorial and regional environmental agencies. For the mapping application, the emissions are directly retrieved from the NPRI database (http://ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98-1#Facility).

3.2 Spatial coverage

The indicators are calculated at the national level. Air pollutant emissions are also available at the facility level in the CESI mapping application. Note that the emissions at the provincial and territorial level were not available at the time of the compilation of the indicators.

3.3 Temporal coverage

The latest year available for the Air Pollutant Emissions indicators is 2012. Past years (1990-2011) are also available at the national level. For facility emissions, information on key air pollutants is available for 2002 to 2012. All emissions used for the air pollutant emissions indicators are annual values.

3.4 Data completeness

The APEI summaries and trends (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1) are compiled to provide the best information available on all significant sources of key air pollutants. As such, improvements to data completeness are made periodically as new emission estimation methodologies are adopted and additional information is made available. The historical emissions are also updated with these new improvements.

3.5 Data timeliness

The data are current up to 2012. The CESI Air Pollutant Emissions indicators are reported approximately one year after data collection, validation, calculation and interpretation of the data have been completed.

4 Methods

Emissions are estimated or measured through one of the following methods:

- Continuous emission monitoring systems (CEMS)
- Predictive emission monitoring (PEM)
- Source testing
- Mass balance
- Site-specific emission factors
- Published emission factors
- Engineering estimates
- Special studies

The methodologies used to estimate emissions are reviewed, updated and improved on a periodic basis. Collaborative work with sector experts from within or outside Environment Canada is undertaken to incorporate available expertise and the latest advancements in scientific knowledge. Further information on these methods is available through Environment Canada's NPRI website on air pollutant emissions (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=5C71562D-1), as well as through the document entitled *Air Pollutant Emissions Inventory & Trends: Methodology, Summary & Highlights* which is available upon request.

In the comprehensive emissions tables, the APEI includes four emissions sources: area, open, mobile, and point (stationary) sources. Emissions are compiled using top-down and bottom-up approaches, which are described below.

Area and open source emissions are sources too small or too numerous to be reported individually as point sources (e.g. dry cleaning). They are usually compiled through a top-down approach using activity-level statistics and emission factors that are specific to the source. Activity levels are multiplied by emission factors to estimate the emissions for the specific source.

Mobile source (transportation) emissions are compiled using a combination of bottom-up and top-down approaches. Emissions are estimated using models that consider the number of vehicles, the fuel consumed, the distance travelled, technology used and many other parameters (e.g. MOBILE Canadian model).

Point source emissions are compiled through a bottom-up approach starting with emissions from facilities. The facility information reported to the NPRI is used in combination with some provincial information to compile the emissions from point sources.

The comprehensive emissions tables contain all four emissions sources (area, open, mobile and point sources). Care is taken to avoid double counting of emissions for the same source. A reconciliation of the emissions is conducted when point source emissions are already accounted for in the area source estimates. In these cases, the area source estimates are modified (reduced or removed) to avoid double counting. A data quality control process is also in place to avoid discrepancies in the database, both in data compilation and in the production of summary tables.

Canadian Environmental Sustainability Indicators (CESI) classifies emissions by summarizing emissions from multiple sources as defined in the APEI sources. The table shows the allocation of air pollutant emission sources reported by CESI with those reported by APEI.

Table 1: Comparison of sources used in CESI and APEI

CESI Sources	APEI Sources
Paints and Solvents	General Solvent Use
	Surface Coatings
Incineration and Miscellaneous	Incineration Sources
	Cigarette Smoking
	Dry Cleaning
	Marine Cargo Handling Industry
	Meat Cooking
	Refined Petroleum Products Retail
	Printing
	Structural Fires
	Human
	Other Miscellaneous Sources
	Waste
Home Firewood Burning	Residential Fuel Wood Combustion
Fuel for Electricity and Heating	Electric Power Generation (utilities)
	Commercial Fuel Combustion
	Residential Fuel Combustion
Off-Road Vehicles	Off-road Use of Diesel
	Off-road Use of Gasoline/LPG/CNG
Transportation (Road, Rail, Air, Marine)	Air Transportation
	Heavy-Duty Diesel Vehicles
	Heavy-Duty Gasoline Trucks
	Light-Duty Diesel Trucks
	Light-Duty Diesel Vehicles
	Light-Duty Gasoline Trucks
	Light-duty Gasoline Vehicles
	Marine Transportation
	Motorcycles
	Rail Transportation

CESI Sources	APEI Sources
	Tire Wear and Brake Linings
Industry	Oil and Gas Industry, and Other Industries
Oil and Gas Industry	Upstream Petroleum Industry
	Downstream Petroleum Industry
Other Industries	Abrasives Manufacture
	Aluminum Industry
	Asbestos Industry
	Asphalt Paving Industry
	Bakeries
	Cement and Concrete Industry
	Chemicals Industry
	Mineral Products Industry
	Foundries
	Grain Industries
	Iron and Steel Industries
	Iron Ore Mining Industry
	Mining and Rock Quarrying
	Non-Ferrous Smelting and Refining Industry*
	Pulp and Paper Industry
	Wood Industry
	Petroleum Product Transportation and Distribution
	Other Industries
	Metal Fabrication
	Glass Manufacture
	Vehicle Manufacture (Engines, Parts, Assembly, Painting)
	Electronics
	Plastics Manufacture
	Food Preparation
	Paint and Varnish Formulation
	Textiles
	Miscellaneous Industrial Sectors
	Biofuel Production
Agriculture (Livestock and Fertilizer)	Agriculture

Note: * Non-Ferrous Smelting and Refining is also showed as an individual source for the sulphur oxides pollutant.

5 Caveats and limitations

The emissions charts and tables show total emissions without natural sources, such as biogenics[3] and open sources such as construction operations and road dust. These sources were excluded with the exception of ammonia emissions from the agricultural source and waste sources for all pollutants. These sources cannot be controlled through conventional means. They were removed from the analysis to not undermine the impact of other important sources. For more analysis including the open sources, please consult the data highlights (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1#X-201302081512532) of the 2012 Air Pollutant Emission Summaries and Historical Emission Trends.

The air pollutant emissions indicators continue to evolve. Improvements are made every year to methodologies for estimating and compiling emissions summaries and analyzing trends. As a result of these improvements, emissions for a given year may be different from those previously published by Environment Canada, other governmental agencies and international organizations. Caution is advised when comparing different reports.

Some area sources emissions were not updated for 2012 due to activity level statistics not available at the time of the compilation. In these cases, the emissi
on estimates from the most recent year were used (2011 data).

6 References and further reading

6.1 References

Environment Canada (2014) 2012 Air Pollutant Emission Summaries and Historical Emission Trends. Retrieved on 15 February, 2014. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1.

Environment Canada (2014) National Pollutant Release Inventory (NPRI) Database. February 2014 version. Retrieved on 21 February, 2014. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98-#Facility.

Environment Canada (2014) National Pollutant Release Inventory (NPRI) - Pollution Data and Reports. Retrieved on 15 February, 2014. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1.

6.2 Further reading

Environment Canada (2014) Guide for Using and Interpreting National Pollutant Release Inventory (NPRI) Data. Retrieved on 8 January, 2013. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=B5C1EAB8-1.

[3] Biogenic emissions refer to emissions of volatile organic compounds from vegetation and emissions of nitrogen oxides from soil.

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